CLAIMS

What is claimed is:

1. An optical characteristic inspection system comprising:

a layer of photo-elastic material that overlays a portion of a structure;

a signal emitting component that delivers a signal to the photo-elastic material, the signal is directed through the photo-elastic material along an axis of rotating structure; and

an analysis component that receives light exiting the photo-elastic material, the exiting signal associated with structural degradation characteristics.

2. The system of claim 1, the structure is at least one of a shaft, a coupler, and a composite joint.

3. The system of claim 1, the structural degradation characteristics are at least one of fatigue, cracking, breakage, rate of degradation, amount of degradation, and misalignment.

4. The system of claim 1, the signal is at least one of: an optical signal, an electromagnetic signal, a RF signal, and an IR signal.

5. The system of claim 1, further comprising an alignment component, that determines axial and lateral misalignment.

6. The system of claim 1, further comprising a joint integrity verifier, which detects defective composite joints.

7. The system of claim 1, further comprising an early breakage detector, which monitors at least one of fatigue, cracking and early signs of breakage.

8. The system of claim 5, further comprising a correction component, which modifies parameters of the structure, based at least in part on information received from the alignment component.

9. The system of claim 8, wherein the correction component utilizes smart material.

10. The system of claim 9, wherein the smart material is at least one of a Sharp Memory Alloy, a piezoelectric ceramic and a electroactive polymer.

11. The system of claim 6, further comprising a correction component, that modifies parameters of the structure, based at least in part on information received from the joint integrity verifier.

12. The system of claim 7, further comprising a correction component, which modifies parameters of the structure, based at least in part on information received from the early breakage detector.

13. The system of claim 1, further comprising an artificial intelligence (AI) component.

14. The system of claim 13, the AI component comprising at least one of: a neural network, an expert system, a support vector machine (SVM), a Bayesian belief network, a data fusion system.

15. The system of claim 1, the photo-elastic material comprising a notch coated with a reflective substance and cut at an angle to direct light along a longitudinal axis of the substrate.

16. The system of claim 1, wherein at least one collar of the photo-elastic material is coated with a reflective substance.

17. The system of claim 16, the light passing along a longitudinal axis of the structure twice, initially transmitted and then reflected.

18. The system of claim 1, the photoelastic material comprising at least one of: a polycarbonate-based compound, a polyester-based compound, a polysulfone-based compound, a polyether sulfone-based compound, a polystyrene-based compound, a polyolefin-based compound, a polyvinyl alcohol-based compound, a cellulose acetate-based compound, a polyvinyl chloride-based compound, a polymethyl methacrylate-based compound, a polyacrylate-based compound, a polyamide-based compound and/or a combination thereof.

19. The system of claim 1, the structure comprising a non-rotating component.

20. The system of claim 19, the non-rotating component comprising at least one of: a bridge structure, an aircraft component, an industrial machine, and a crane.

21. The system of claim 1, the signal emitting component and the analysis component remotely connected to the photo-elastic layer utilizing fiber optical cable.

22. The system of claim 1, further comprising a control component that provides a pulse of known amplitude to the system.

23. A method that determines characteristics of a structure comprising:

injecting a signal into a photo-elastic material on a portion of a structure;

receiving a signal exiting the photo-elastic material, the exiting signal having mechanical wear characteristics relating to the structure; and

analyzing the characteristics of the structure utilizing the received signal.

24. The method of claim 23, wherein the signal comprises a fringe pattern.

25. The method of claim 23, wherein analyzing determines at least one of shaft fatigue, cracking, early signs of breakage; axial misalignment, lateral misalignment, and composite joint failure.

26. The method of claim 25, querying whether correction is needed based on analysis performed on the received signal.

27. The method claim 27, correcting the characteristic of the structure as determined by the query.

28. A system that monitors structural characteristics comprising:

means for directing a light from a light source into a photo-elastic material on a portion of a structure;

means for receiving the light exiting the photo-elastic material, the exiting light having at least one of mechanical degradation and alignment characteristics relating to the structure; and

means for analyzing the characteristics of the structure utilizing the received light.